Mobile Netw Appl (2013) 18:591–593
DOI 10.1007/s11036-013-0474-7

"Security-Aware and Data Intensive Low-Cost Mobile Systems" Editorial

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Published online: 13 October 2013

We are witnessing a paradigm shift in the way mobile devices are being used and operated. What was once a voice network is now predominantly a data network. As a consequence, end-users are now using mobile systems for applications that fall under the data intensive paradigm, such as Skyline queries, streaming information relays, and crowd sourced disaster management. However, this paradigm shift has opened new research directions, such as: **(a)** Security, as the system now has numerous distributed entry points and the behavior of a malicious entity does not really correlate with any previously known phenomenon (e.g., Internet virus attacks, DOS attacks, etc.). **(b)** Data interoperability that must cater to the fundamental issue that mobile devices are required to work seamlessly with Internet data, thus requiring revision of protocols, data exchange frameworks to improve data sharing among mobile devices and with the Internet. **(c)** Sustainable software development that entails the development of software models for mobile devices that have a longer life-cycle and require fewer updates. This also effectively translates into an economically viable mobile system. Privacy and security aspects need to be covered at all layers of mobile networks, from mobile users' devices, to privacy-respecting credentials and mobile identity management.

All of the above mentioned research domains are complex on their own, which makes it a very attractive research area for academia and industry. The eventual goal is to make the mobile systems seamless integrate with Inter and Intranet devices without a measurable performance degradation. Is is arguably required to investigate novel methods and techniques to enable secure access to data, network nodes and services, flexible communication, efficient scheduling, self-adaptation, decentralization, and self-organization.

This special issue herewith presents six research papers with novel concepts in the analysis, implementation, and evaluation of the next generation of intelligent scalable techniques for data intensive processing and security related problems in modern mobile environments. The first three papers span the fields of key management, power modeling and mobility modeling, but all share a relevance to security aspects.

Cryptographic and key management systems in mobile networks must be computationally low-cost because of the limitations of computational and data storage capacities and battery life of most of the network nodes. Wu and Lin present non-interactive authenticated key agreement (NI-AKA) protocols based on the idea of bilinear pairing-based cryptosystem model and Elliptic Curve Encryption (ECE) scheme. The ECE allows the encryption of message multiple times with different keys that can be decrypted in

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a single run with a single key. During read operation, the owner of the file sends the credential to the network resource and service provider and requesting entity. Theoretical analysis of semantic security of the proposed methodology is provided through a verification of the Decisional Bilinear Diffie-Hellman (DBDH) assumption. The authors prove that the proposed NI-AKA scheme is computationally equivalent to the DBDH.

The problem of optimal energy utilization in mobile networks is not limited to the energy-aware cryptographic schemes and is widely discussed over the last few years, especially in the context of green mobile clouds and Big Data systems. Nacci et al. present the MPower: power-sensing and adaptive power modeling platform for Android mobile devices. Their idea is based on using the mobile device clients for gathering a power-consumption data from real-world users and devices. The functionality of the platform is justified in a comprehensive empirical analysis of 278 mobile devices and 22.5 million data records collected during one year. Their approach facilitates the building of device-centric power models that will allow users to craft better power-management strategies.

Design of adaptive and computationally lightweight techniques for modelling the mobility of devices in wide area networks is one of the critical issues which may have a significant impact on the performance characteristics of the whole system. Niewiadomska-Szynkiewicz et al. address the problem of calculation of mobility trajectories of devices in fully connected cooperative ad-hoc networks. The presented model is based on the concepts of artificial potential field and partition-based mobility generic models. The authors define a simple artificial potential function for the estimation of optimal inter-node distances in the cooperative network. Experiments are provided in outdoor and indoor scenarios on realistic data (with an application to evacuation management in the case of terrorist attack). The results of those experiments show very low distance errors of the predicted (calculated) dynamically changing node locations compared with the further observed (all nodes reached their targets in a relatively short time interval), which confirm the high functionality of the proposed methodology.

The remaining three papers present recent developments in Wireless Sensor Networks (WSNs).

Tziritas et al. address the agent-code mobility problem in WSNs. It is commonly accepted that the network overhead in WSNs plays a significant role in the network longevity. For the above reason, the authors define two algorithms (called ADE and ADE-SW) that perform online decisions to migrate inter-communicating agents aiming at the total network overhead reduction. The proposed algorithms work in a fully distributed way and also take into account the network overhead incurred due to agent migrations. The performance of the algorithms is formally studied via competitive analysis, with the competitive ratio between ADE/ADE-SW and OPT being 3. Tziritas et al. also provide a thorough experimental evaluation for comparing the performance of ADE and ADE-SW to that of a static offline (optimal) algorithm. They also show that when the online algorithms are fine-tuned appropriately, they outperform the offline optimal approach.

In WSNs, the nodes closer to the sink may die faster than the nodes that are farther away from the sink, as they consume more energy for relaying data. To balance energy consumption, the sink-oriented layered clustering (SOLC) methodology proposed by Mo et al. first divides the sensor field into concentric rings centered at the sink, and then computes the optimal ring widths and the numbers of cluster heads in different rings for clustering. The cluster heads in a ring closer to the sink have smaller sizes than those in the rings farther away from the sink. As such, they can spend less energy for intra-cluster data processing and more energy for inter-cluster data relay to improve the network lifetime.

Natural disaster monitoring with WSNs is a well-known data intensive application with high bandwidth requirements and stringent delay constraints. It manifests a typical paradigm of data-intensive application in a low-cost scalable system. Chen et al. first assess the representative works in this area by classifying them within the domains of application of WSNs for disasters and optimization technologies. Chen et al. then describe the design of an early warning system for geohazards in a reservoir region, focusing on issues of: (a) supporting reliable data transmission, (b) handling huge data of heterogeneous sources and types, and (c) minimizing energy consumption.

We believe that all of the papers presented in this Special Issue ought to serve as references for students, researchers, and industry practitioners interested or currently working in the evolving and interdisciplinary area of security-aware and data intensive computing in intelligent mobile systems. We hope that the readers will find new inspiration for their research.

We are grateful to all the contributors of this issue. We thank the authors for their time and efforts in the presentation of their recent research results. We also would like to express our sincere thanks to the reviewers, who have helped us to ensure the quality of this publication. Our special thanks go to the editorial and management teams of ACM/Springer Mobile Networks & Applications (MONET) journal for their great support throughout the entire publication process.

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The main topics of her research are evolutionary computation, mathematical modeling of stochastic processes, grid and cloud computing, intelligent networking, scalable computation, multi-agent systems, global optimization meta-heuristics. She has published in international journals, books and conference proceedings of the research area. Prof. Kołodziej is an author of "Evolutionary Hierarchical Multi-Criteria Metaheuristics for Scheduling in Large-Scale Grid Systems" monograph published by Springer, a guest editor of 3 other books and 12 special issues of highly indexed journals in the domain. She is serving as the editorial board member of several journals in her research area. She serves as a reviewer for the major journals in her research domain, including IEEE Transactions on Evolutionary Computation, ACM Transactions on Autonomous and Adaptive Systems and many others. For more details please refer to http://www.joannakolodziej.org.

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Mario Köppen was born in 1964. He studied physics at the Humboldt-University of Berlin and received his master degree in solid state physics in 1991. Afterwards, he worked as scientific assistant at the Central Institute for Cybernetics and Information Processing in Berlin and changed his main research interests to image processing and neural networks. From 1992–2006, he was working with the Fraunhofer Institute for Production Systems and Design Technology. He continued his works on the industrial applications of image processing, pattern recognition, and soft computing, esp. evolutionary computation. During this period, he achieved the doctoral degree at the Technical University Berlin with his thesis works: "Development of an intelligent image processing system by using soft computing" with honors. He has published around 150 peer-reviewed papers in conference proceedings, journals and books and was active in the organization of various conferences as chair or member of the program committee, incl. the WSC on-line conference series on Soft Computing in Industrial Applications, and the HIS conference series on Hybrid Intelligent Systems. He is founding member of the World Federation of Soft Computing, and also member of the editorial board of the Applied Soft Computing journal, the Intl. Journal on Hybrid Intelligent Systems and the Intl. Journal on Computational Intelligence Research. In 2006, he became JSPS fellow at the Kyushu Institute of Technology in Japan, and in 2008 Professor at the Network Design and Research Center (NDRC) of the Kyushu Institute of Technology, where he is conducting now research in the fields of multi-objective optimization, digital convergence and multimodal content management.